Cooperation in Peaceful Uses of Outer Space in

The Asia-Pacific Region

APSCO

ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

INTRODUCTION

Asia-Pacific Space Cooperation Organization (APSCO), an intergovernmental organization was officially inaugurated in 2008 with objectives to peacefully explore and exploit space science and technology and their applications for promotion of sustainable socio-economic development by strengthening multilateral cooperation for human benefit of the Asia-Pacific region.

A CTIVE INVOLVEMENT IN INTERNATIONAL SPACE AFFAIRS

P EACEFUL USE OF OUTER SPACE

S HARING KNOWLEDGE AND EXPERIENCES

C OLLABORATIVE GAINS WITH ITS MEMBER STATES

O PEN WORLDWIDE TO INTERNATIONAL SPACE COMMUNITIES

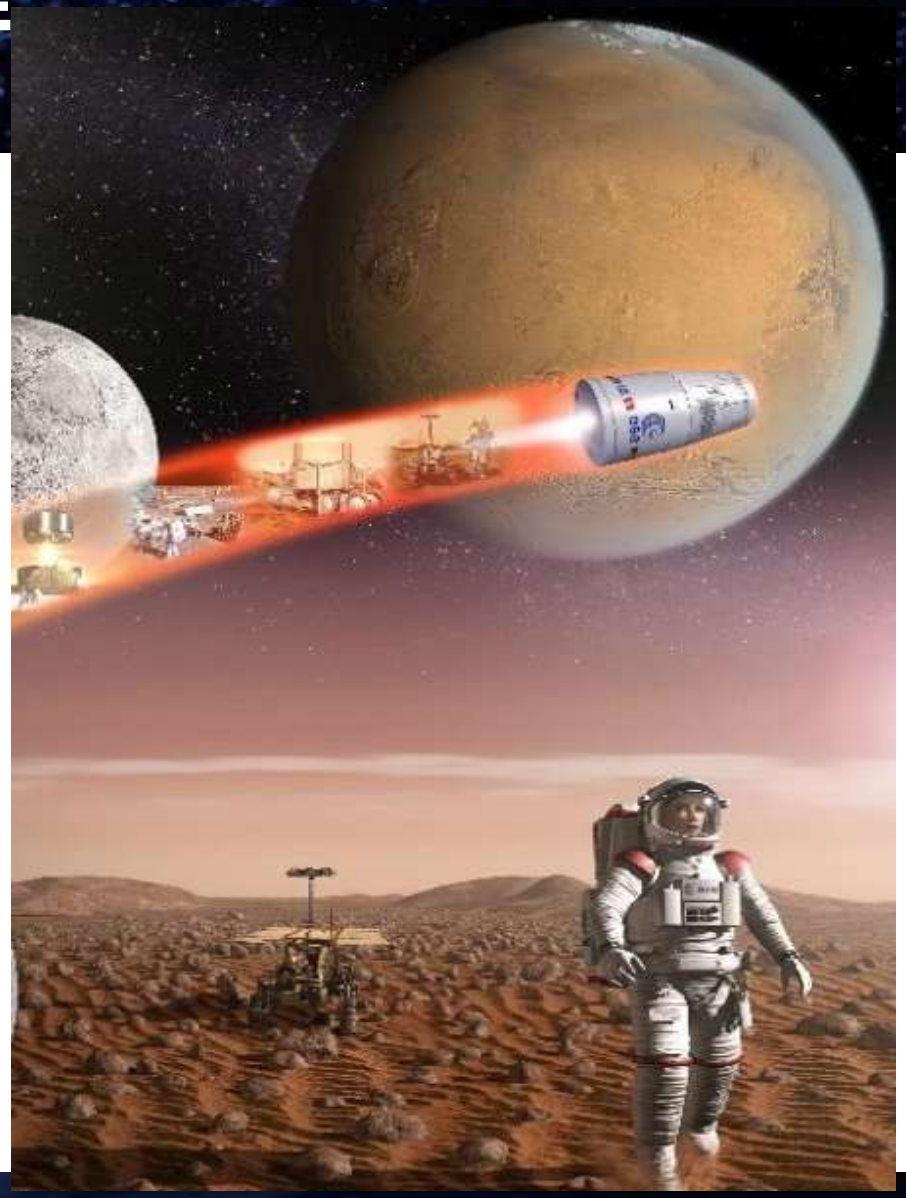
OBJECTIVES OF APSCO

- Developing collaborative space programs among its Member States;
- Assisting Member States in space technology research and development, its applications and training through space development policies;
- Promoting cooperation, joint development, and sharing achievements among the Member States in Space Science, space technology and its applications by tapping the cooperative potential of the region;
- Enhancing cooperation among relevant enterprises and institutions of the Member States and promoting the industrialization of space sector;
- Contribute to the international cooperative activities in space policy and space law; space science; and space technology and its applications for the peaceful uses of outer space

FUNDAMENTAL RESEARCH FOR SPACE TECHNOLOGY AND APPLICATIONS

There are 5 fields in Fundamental research for space technology and applications:

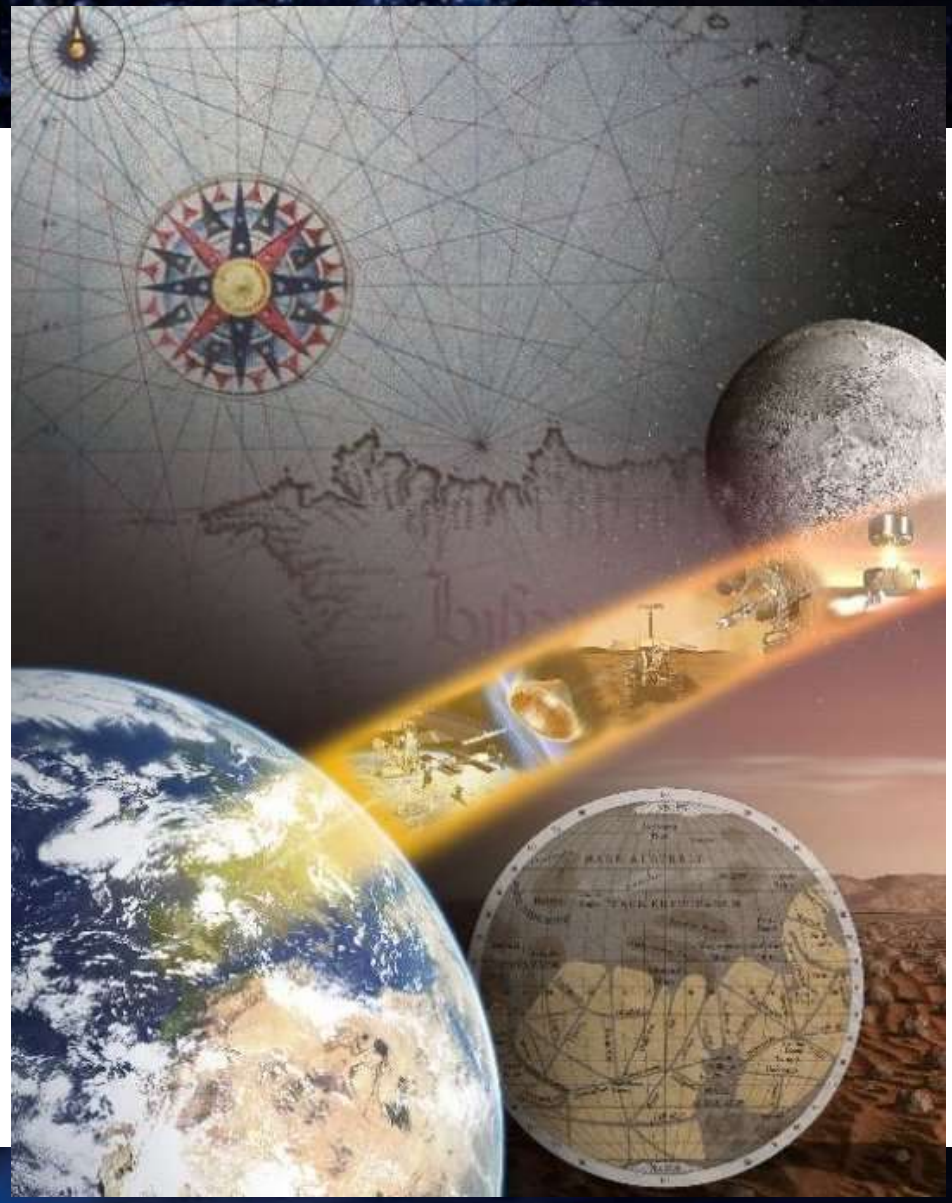
- Activities on Space Science
- Activities on Space Technology
- Data purchasing on space Application
- Activities on Space Application
- Maintenance of Relative Space and Ground facilities



ACTIVITIES ON SPACE SCIENCE

APSCO has been implementing 4 projects in the field Space Science as below:

- Ka band project
- Earthquake Signatures project
- Ionospheric Modeling Project
- Framework Researches on Application of Space Technology for Disaster Monitoring



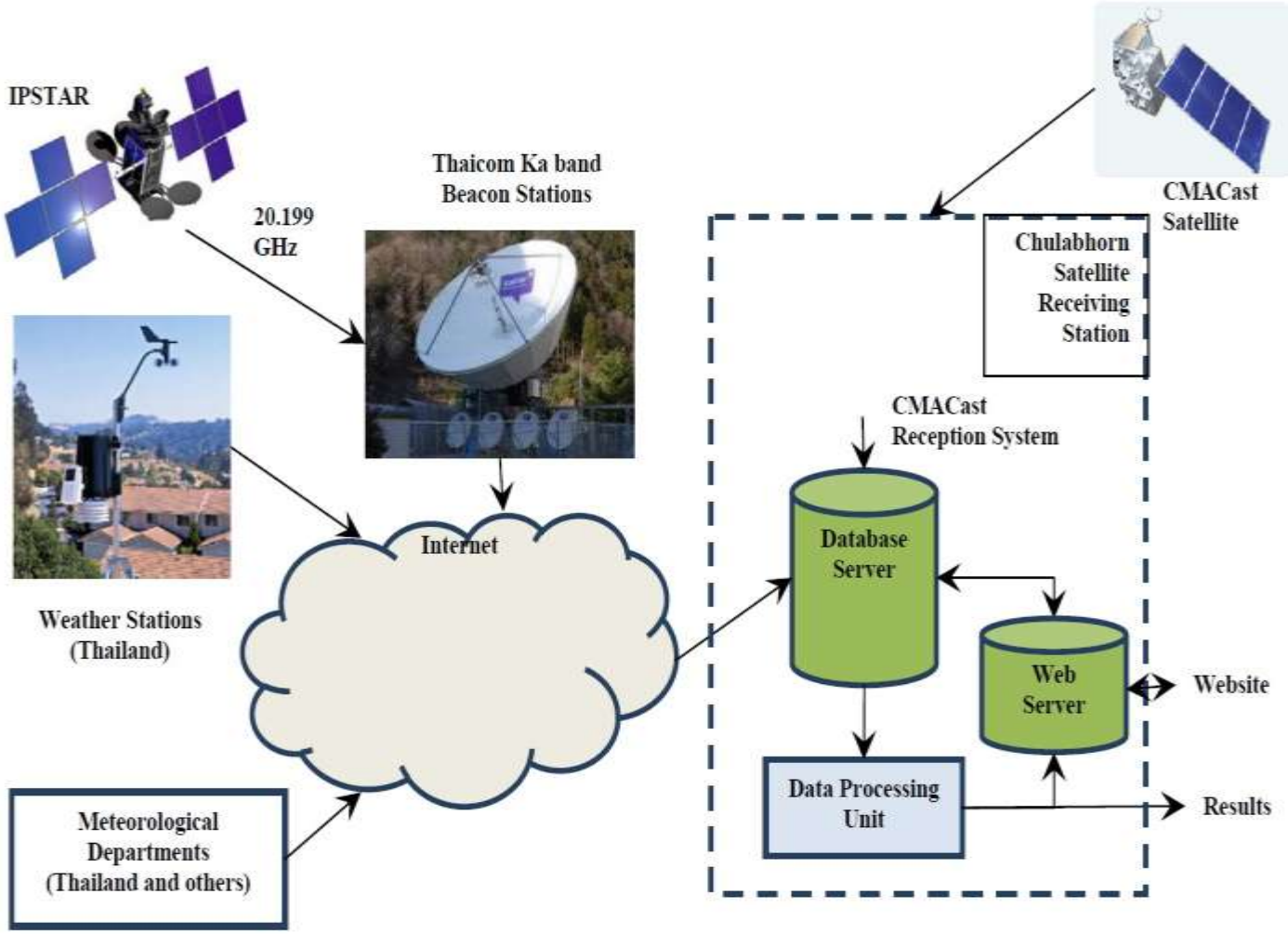
1. “Ka” BAND PROJECT

Project name:

Ka band Rain Attenuation Modeling and Related Research Project

Objectives:

- Create a database from collected Ka band beacon signal strength and related meteorological data for this or further related projects.
- Develop understanding of raining process and its related atmospheric effects concerning signal attenuation for Ka band SATCOM
- Suggest a rain attenuation model based on limited validation and (if necessary) modification of a set of existing models for practical utilization
- Investigate feasibility of a practical site-switching algorithm for (uplink) site diversity



“Ka” BAND PROJECT

Implementation:

- Ka band Rain Attenuation Modeling and Related Research Projects and project was approved to implement as a basic activity by the Sixth Council meeting in 2012.
- The project has been led by Kasetsar University, Thailand.
- The project kick-off, as well as Preliminary Design Review (PDR), was conducted in 2014, in Bangkok.
- The Critical Design Review (CDR) milestone has been accomplished in 2015, where a database from collected Ka Band beacon signals and related met data has been established, and best practice for understanding of rain process and its related atmospheric effects concerning signal attenuation for Ka Band satellite communication has been collected.
- The Technical Demonstration Review (TDR) is planned in, in September, 2016, where a rain attenuation model based on limited validation is expected, and practical site-switching algorithm for uplink site diversity will be proposed.

2. Earthquake Signatures project

Project name:

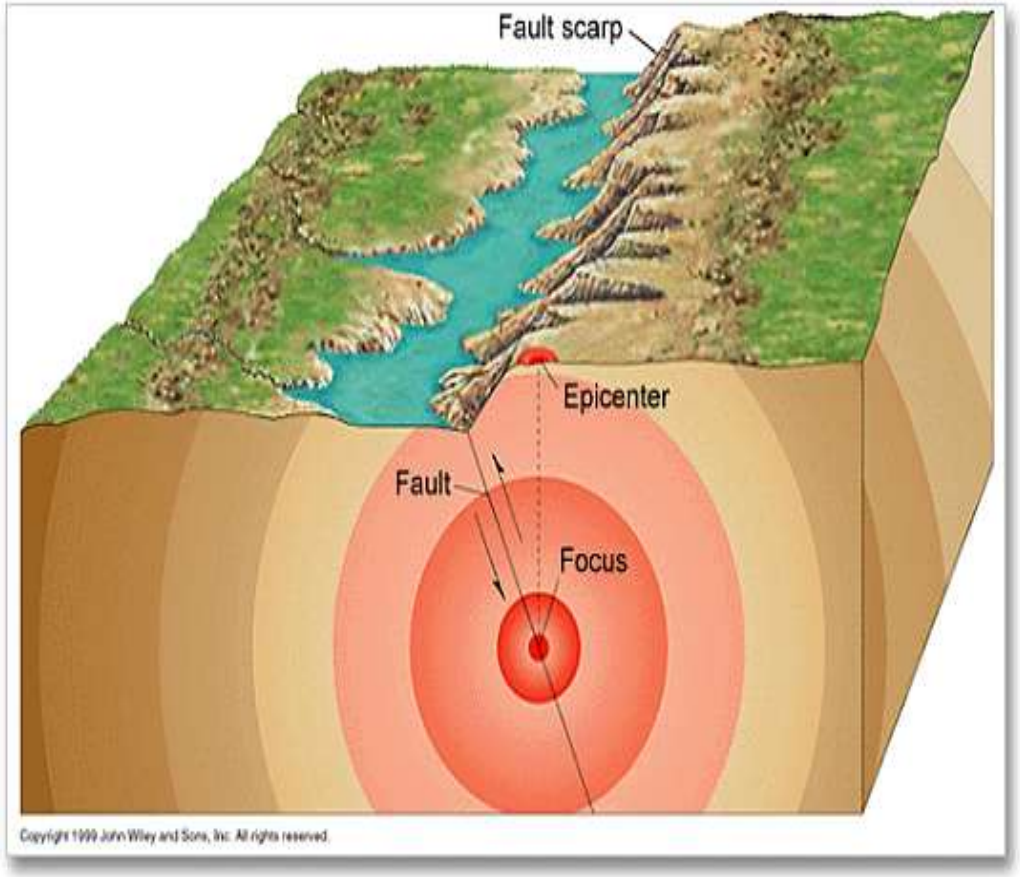
Research on Determining precursor Ionospheric signatures of Earthquakes by Ground based Ionospheric soundings

Purpose:

Integration of all existing ground-based ionospheric monitoring resources in Asia-Pacific including ionosphere altimetry, GPS TEC, VLF radio wave observations and construction of Asia-Pacific ground-based ionosphere monitoring information sharing platform for service users in the member states based on APSCO Data management publishing system, they will help to achieve sharing service of ground-based ionosphere monitoring data in Asia-Pacific.

Objectives:

- Builds the Asia-pacific region Foundation ionosphere monitoring and data sharing platform.
- Builds digital ionospheric model.
- Makes the research of earthquake ionospheric characteristics
- Promote the research of ionosphere coupling mechanism.



Earthquake Signatures project

Implementation:

- The project was approved for implementation as basic activity by the 7th Council meeting.
- Kick off Meeting was held during 21st to 23rd October of 2014 in the Headquarters of APSCO.
- The PDR Meeting was held during 8th to 10th April of 2015 in Sanya of China. This year the Critical Design Review milestone has also been accomplished.
- Meanwhile, the Ground-based Ionospheric Monitoring and Information Sharing Platform (GIMISP) has already been established at the China Earthquake Administration (CEA) and ready for commissioning. It aims to integrate all ground-based ionosphere monitoring resources and information sharing platform in APSCO Member States. Thus, bilateral agreement on data provision and sharing between the Project Lead, CEA, and each Member State has been drafted. So far, Mongolia, Peru and Thailand have already signed the agreement, while the others are still under coordination.

During the Kick-Off Meeting, 21-23 Oct, 2014, at the Headquarters of APSCO

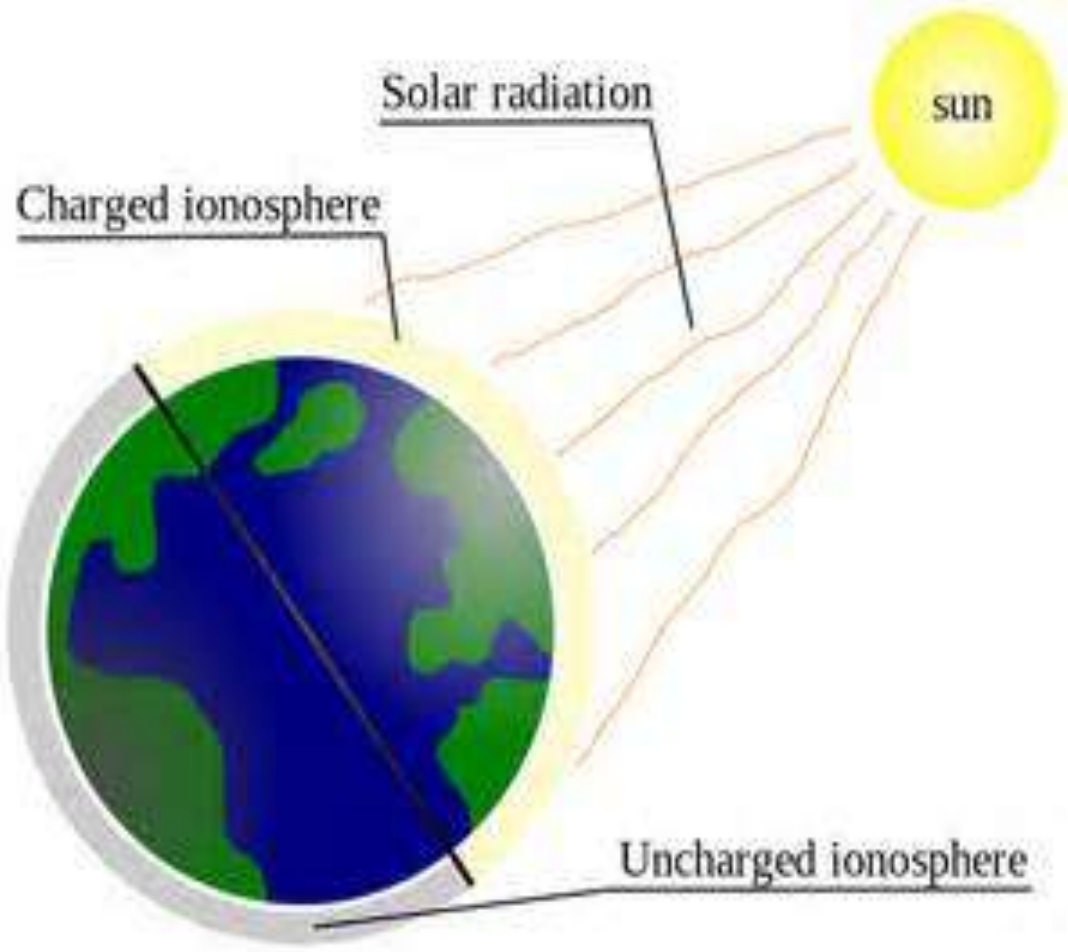
3. Ionospheric Modeling through Study of Radio Wave Propagation and Solar Activity project

Purpose of project:

- The project aims to establish the ionospheric model in the Asia-Pacific region for APSCO M.S. through study of radio wave propagation and solar activity, and to provide cooperative missions of ionospheric related research to M.S.

Objectives of project:

- Establish a Continuous Ionospheric Observation Network jointly in Asia-Pacific region which can provide multi-parametric ionospheric measurement with high accuracy and high resolution.
- Assess ionospheric model with collecting data from the to-be-established continuous ionospheric observation system and other ionospheric data sources available among the Asia-Pacific region.
- Improvement of ionospheric model in Asia-Pacific region for MS of APSCO by using data from the ionospheric observation network and available knowledge.



Ionospheric Modeling through Study of Radio Wave Propagation and Solar Activity project

Implementation:

- The project was approved by the 9th Council Meeting as Optional Activity. Bangladesh, China, Mongolia, Pakistan, Peru and Thailand participate in the project with the leading role by China Research Institute of Radio Wave Propagation (CRIRP).

- The project Kick-Off has been successfully organized in May, 2016, in Qingtao, China.

- The Project Implementation Agreement has been signed between APSCO Secretariat and the leading entity. With its key aim proposed to establish a continuous Ionospheric monitoring network in APSCO Member States to provide near real-time Ionospheric alert and short-term prediction, the bilateral MOU on measurement equipment installation and data provision is also proposed between the Project Lead and each Member State during the meeting.

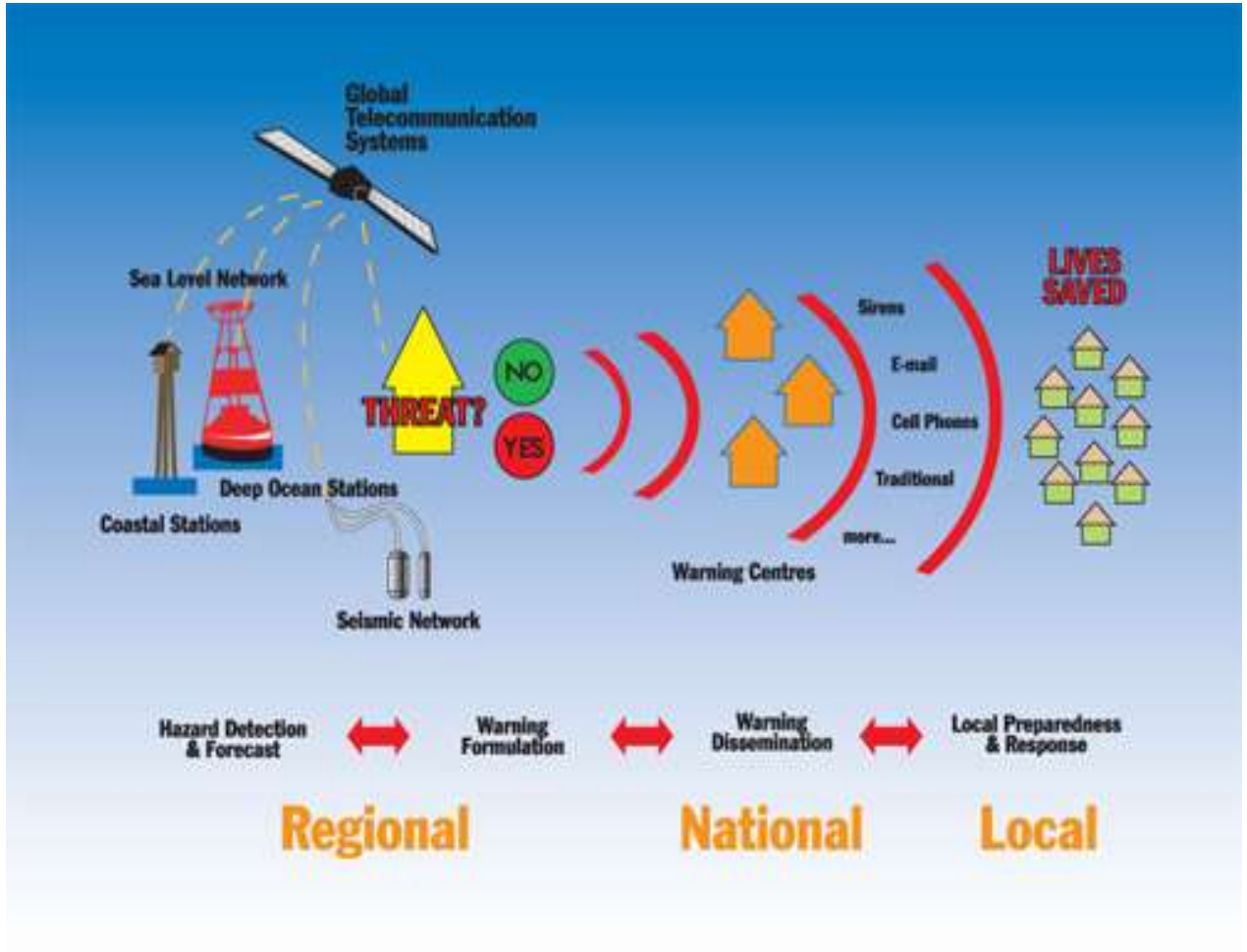
4. Framework Researches on Application of Space Technology for Disaster Monitoring

Project name:

Establishment of a Framework for Researches on Application of Space Technology for Disaster Monitoring in the APSCO Member States

Purpose:

- To establish a framework to facilitate joint research works on the application of
- To enhance the technical knowledge of relevant manpower of APSCO MS through researches/technology transfer to assist APSCO MS to establish/strengthen space technology based operational systems for monitoring disaster.



Framework Researches on Application of Space Technology for Disaster Monitoring

- The project approved by the 9th Council Meeting to implement as a basic activity.
- The Kick-off Meeting on The Establishment of a Framework for Researches on Application of Space Technology for Disaster Monitoring in the APSCO Member States Project was held in Dhaka, Bangladesh from 28th to 30th March 2016.
- The Project Implementation Agreement was signed between APSCO Secretariat and the leading entity, SPARRSO.
  - Four priority disaster sources, namely, flood, Earthquake, landslides/avalanches and drought were given priority to be addressed in the project. The first technical session, however, has to be postponed from October, 2016 to January, 2017, due to budget deficiency.

During the Kick of Meeting, March 28-30, 2016, Bangladesh

Individual Country Activities 1: Bangladesh

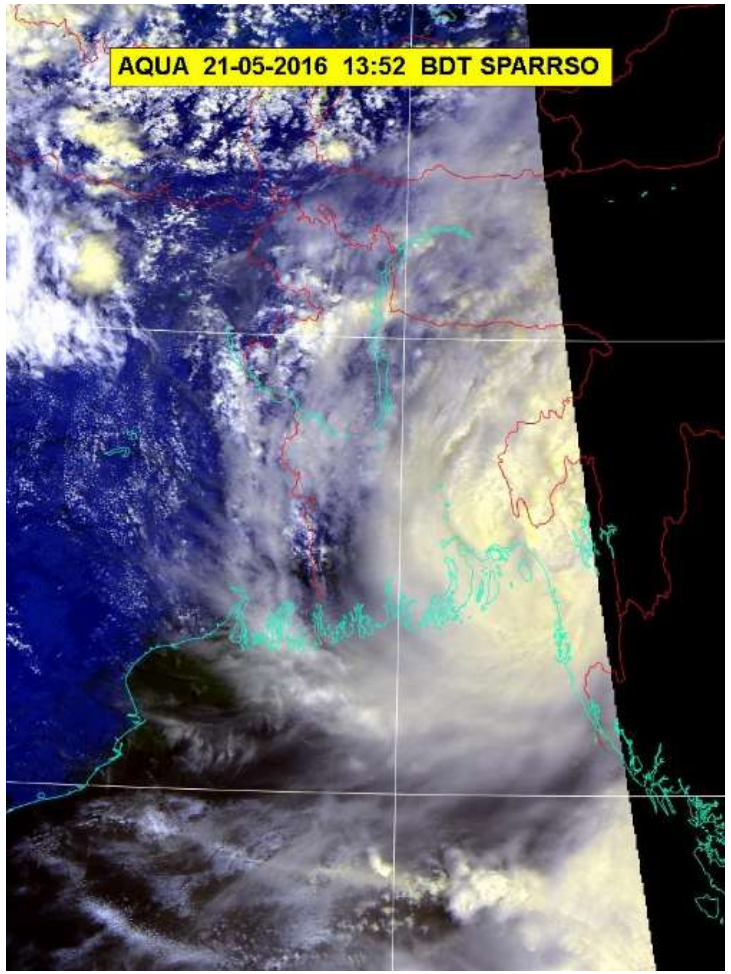
Activities of SPARRSO

- **Food Security**
  - Estimation of **rice production** using MODIS data
- **Disaster**
  - Tracking of **cyclone**
  - Affected areas of **Sundarbans** due to **cyclone** sidr
- **National Contribution**
  - Digital enumeration area map at **mouza** level
  - Selection of site for the landing station of **submarine cable**
- **Monitoring**
  - Expansion of **shrimp farming** areas
  - Monitoring of Ever changing **Courses** of **Ganges-Jamuna**
  - Monitoring of Coastal **Mangrove Afforestation** of Bangladesh
  - **Flood Plain** mapping

Individual Country Activities 1: Bangladesh

Ongoing Activities

- Satellite-based **Monitoring** of **Boro**, **Aman Rice** and **Potato**
- Map of **major Flood** affected area (July-August, 2016)
- Exercise on Estimation of **Damages** Created by the **Cyclone Roanu**
- Mathematical modeling of the soil-vegetation-water system: **Quantitative** information retrieval **PRV algorithm**, **SMAC algorithm**, CSAR



Individual Country Activities 1: Bangladesh

Future Plan

- Design and Construction of **Drone/UAV** and low cost **Micro-satellite** under Asian Micro-Satellite Consortium (**AMC**)
- Establishment of Remote Sensing based Damage Assessment i.e effect of **Drought**, **Cyclone** and **Saline Water** on **Agricultural Crop**.
- Integrated **River Monitoring** System, Development of model for estimation of **damages by flood**
- Regular mapping of **fishing zones** in the sea areas of Bangladesh.

Individual Country Activities 2: China

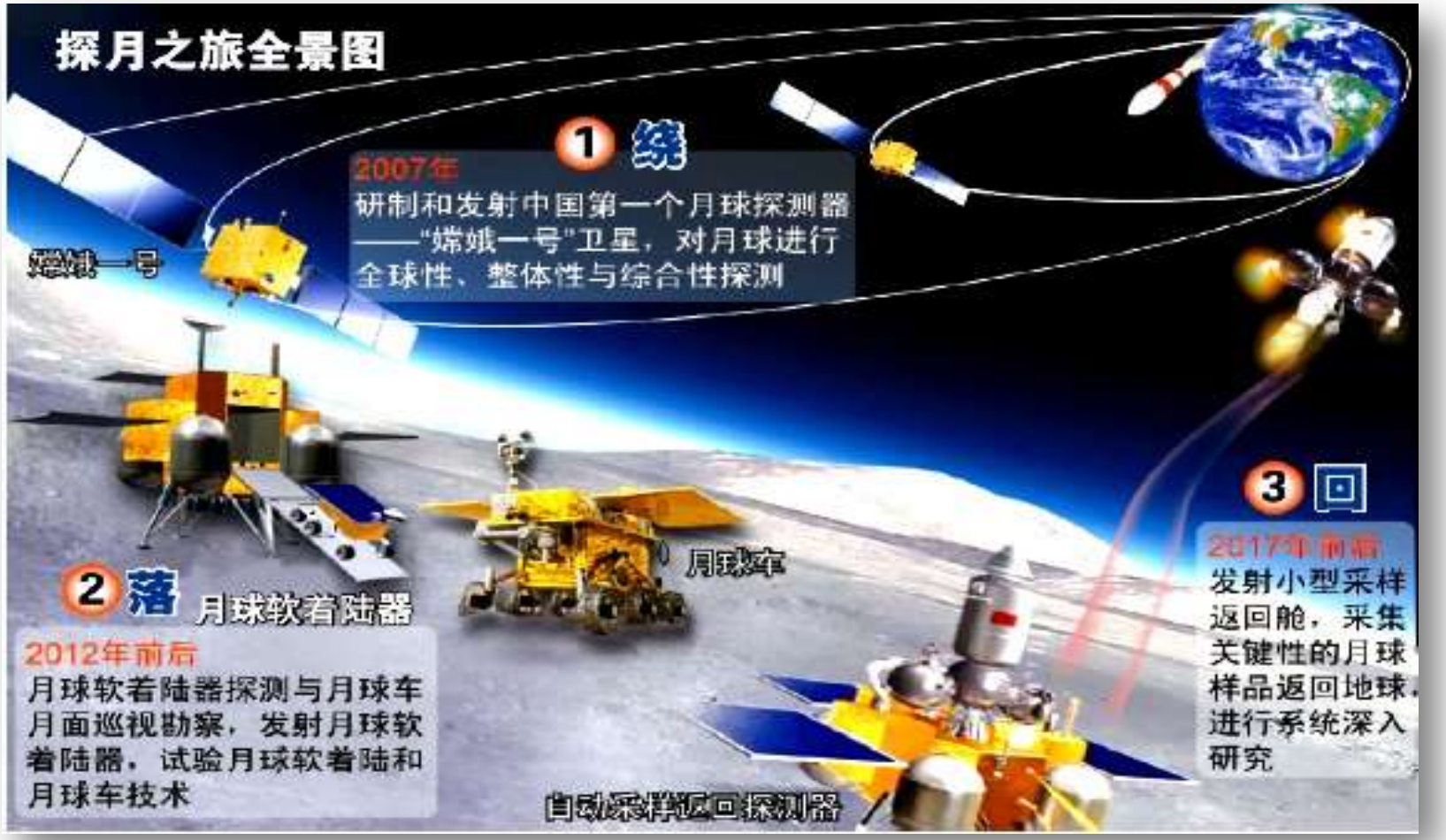
Space Science on Manned Missions

- **15 Sept. 2016**, Tiangong-2 was launched with 14 experiments on board. 24-25 Sept. They were briefly checked. All of them are working properly.
- **17 Oct. 2016**, SZ-11 was launched with two Taikonauts (Hang Tian Yuan). 19 Oct., after the docking, they will entre the big apartment and stay there for 30 days.

Individual Country Activities 2: China

Lunar and Deep Space Exploration Program

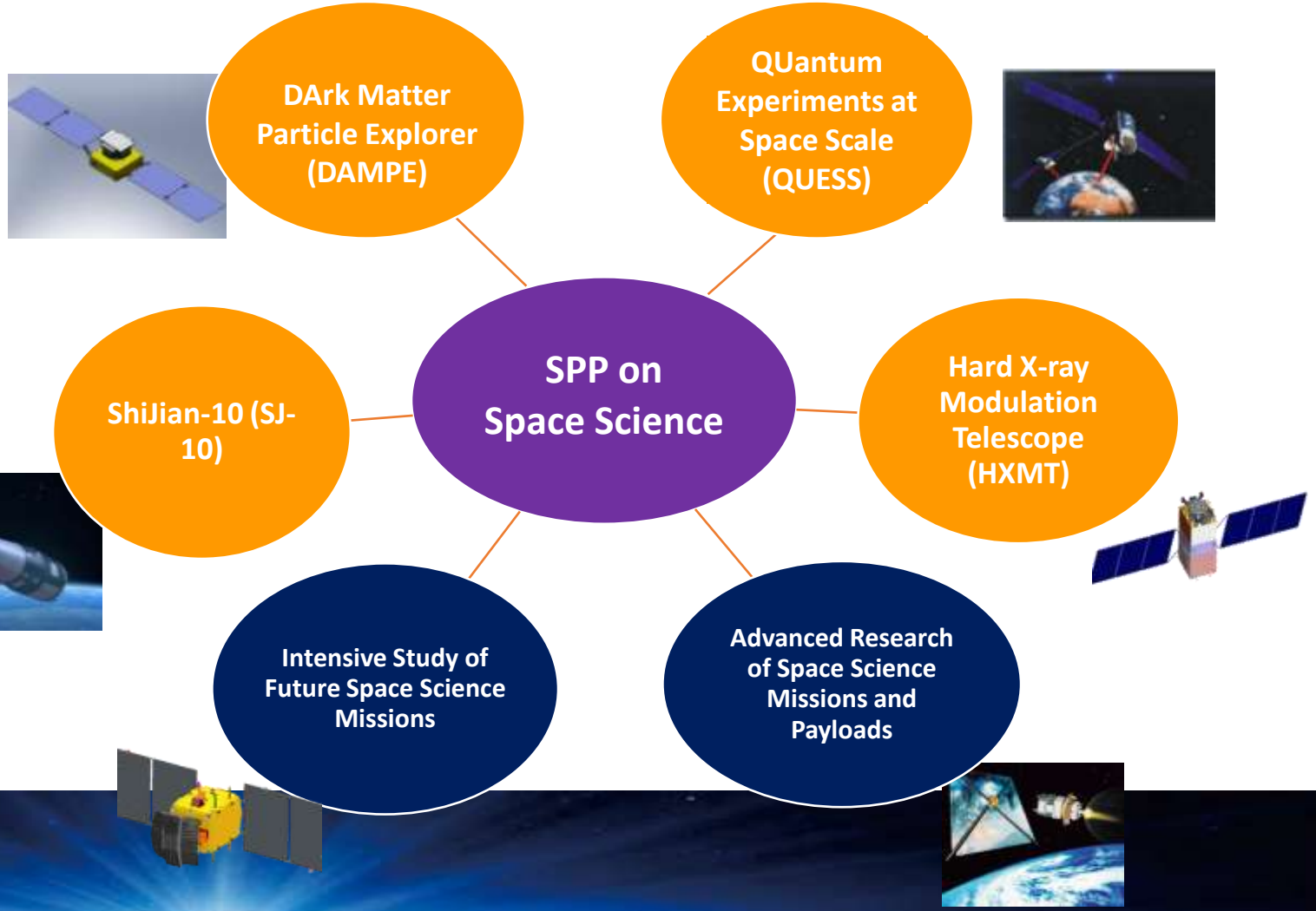
- **End of 2017**, CE-5 will be launched. 200g lunar soil will be sampled and returned to the earth.
- **Mid. 2018**, CE-4 communication relay satellite will be launched to Eeath-Moon L2 point. And about half year later, CE-4 will be launched and intended to land on the far side of the Moon, first time of the human beings.
- **Mid. 2020**, Chinese Mars mission will be launched with an orbiter + a rover.



Individual Country Activities 2: China

Strategic Priority Program On Space Science

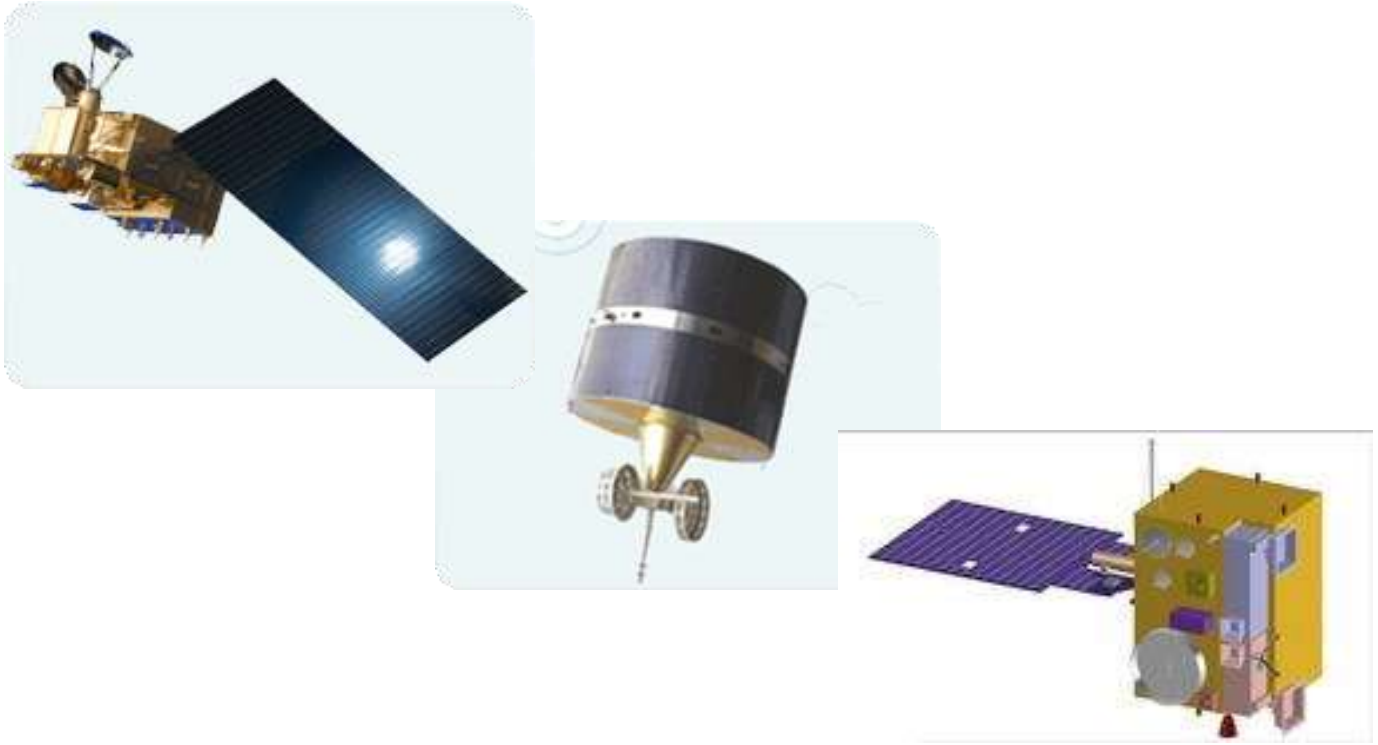
- **31 Mar. 2010**, No.105 Executive Meeting of the State Council was taken, which approved *Innovation 2020* of the Chinese Academy of Sciences to take the lead to implement Strategic Priority Program
- **11 Jan. 2011**, CAS officially approved the SSP on Space Science for kick-off



Individual Country Activities 2: China

Feng Yun Series for Weather

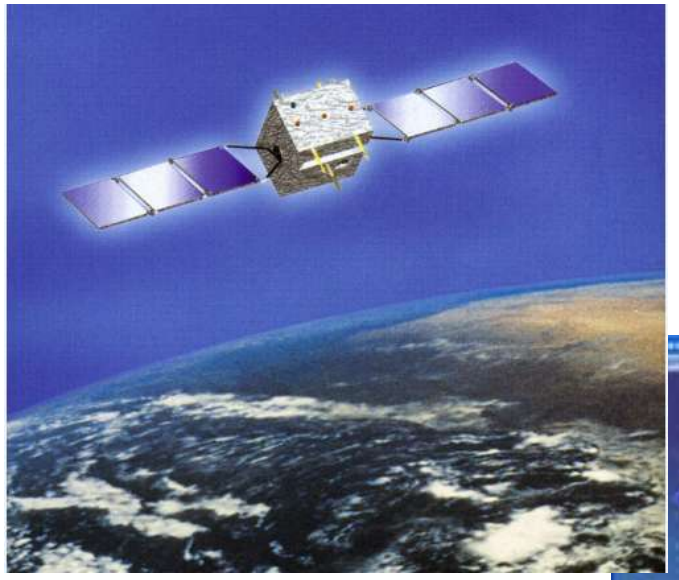
- FY – 3 … For polar orbit
- FY – 2 … For geostationary orbit
- FY – 4 … For geostationary orbit (new generation)

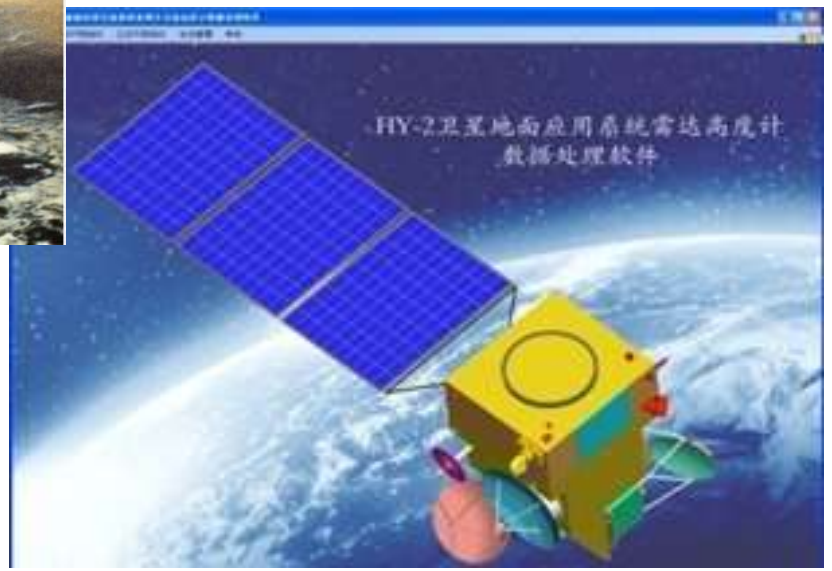


Individual Country Activities 2: China

Hai Yang Series for Ocean

- HY – 1 … For ocean colours
- HY – 2 … For ocean dynamics
- HY – 3 … For SAR topography



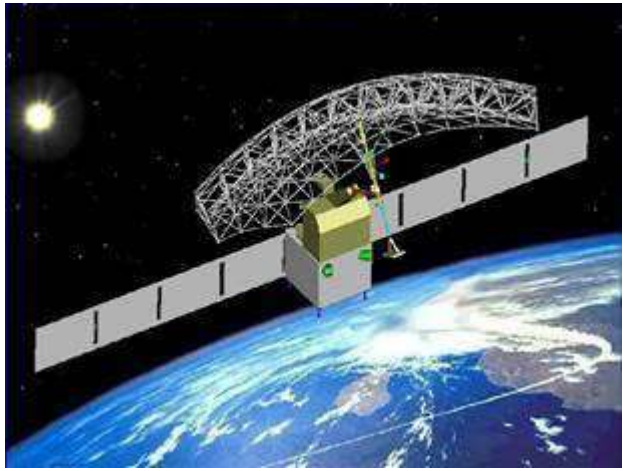


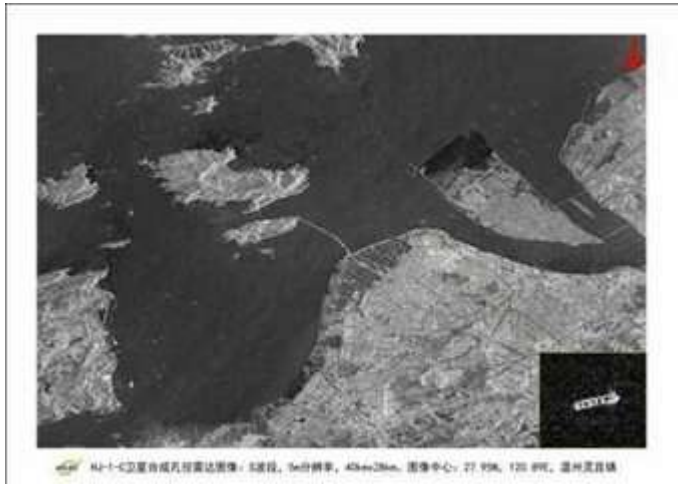
Individual Country Activities 2: China

Disasters Monitoring Series

- HJ – A, B … For optical

- HY– C … For SAR

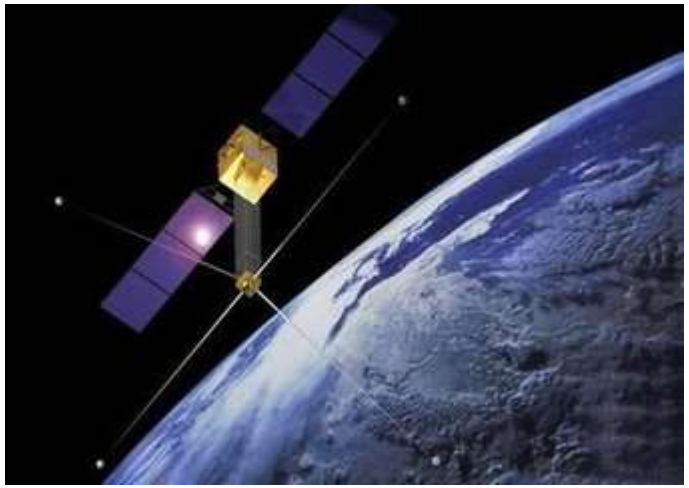




Individual Country Activities 2: China

Seismic Electromagnetic Satellite

- CSES … For earthquake detection experiments
  - magnetic field of the earth
  - ionosphere plasma
  - electrons, and ions
  - low frequency EM waves



Individual Country Activities 2: China

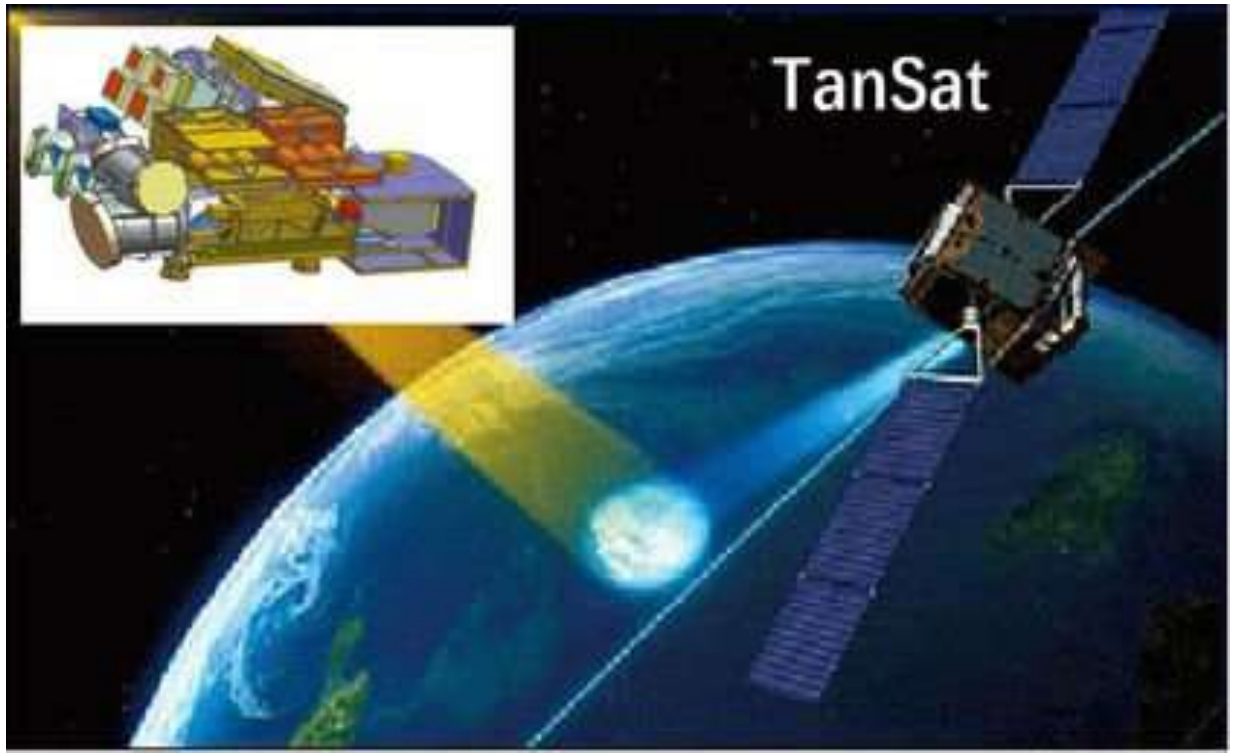
CO_2 monitoring Satellite

Satellite Specifications

- Orbit：700km, sun-synchronous, 98.2°
- Mass：≤650kg
- Lifetime：3 years
- Retrieval of atmospheric CO_2 accuracy：4ppm

Payloads

- CO_2 Spectrometer
- Cloud and Aerosol Polarimetric Imager (CAPI)



Individual Country Activities 2: China

SVOM for Gamma Ray Burst Detection

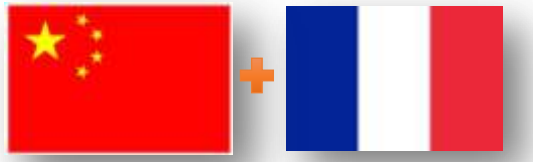
- Orbit：600km, circular, Inc. 30°
- Precession period：60 days
- Satellite orientation：quasi anti-sola

45 cm Visible Telescope
- 400 to 950 nm
- FoV of 21'x21'

Gamma-Ray Monitor, a set of two gamma-ray spectro-photometers
- 50 keV to 5 MeV.
- same FoV of ECLAIRs

ECLAIRs, a 2D-coded mask imager
- 4 ~ 250 keV, hard X-ray
- field of view of 80° x 80°
- localization accuracy better than 10', at 7 s.

MXT, a micro-channel X-ray telescope
- 0.3 to 7 keV
- FoV of 1.1°
- localization accuracy better than 20'', at 5 s.

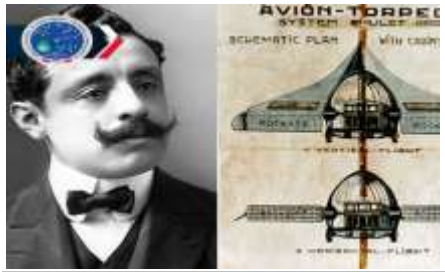


Individual Country Activities 3: Peru

Current Activities

- Launcher development
- Remote Sensing, GIS
- Micro/nano satellites
- Astronomy
- Science Instrumentation

Individual Country Activities 3: Peru



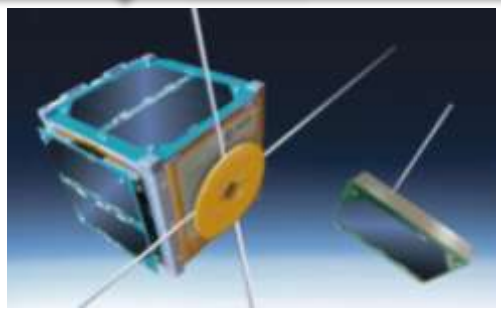
Torpedo-Plane, design by:
Eng. Pedro Paulet

Launching Vehicle
Paulet IB

Launch of: UAPSAT-1. University:
Alas Peruanas

1904 2006 2013 2014

Launching Vehicle
PAULET-I



Launch of: PUCP-Sat-1, &
Pocket-PUCP,
Catholic University of Peru

Development time lines

Individual Country Activities 3: Peru

Time lines (continued)

Launch of Nanosat Chasqui:
National University of Engineering

2014

National Operations
Center of Satellite Images

2015

Launch of PeruSat-1

2016

Paulet II

2017

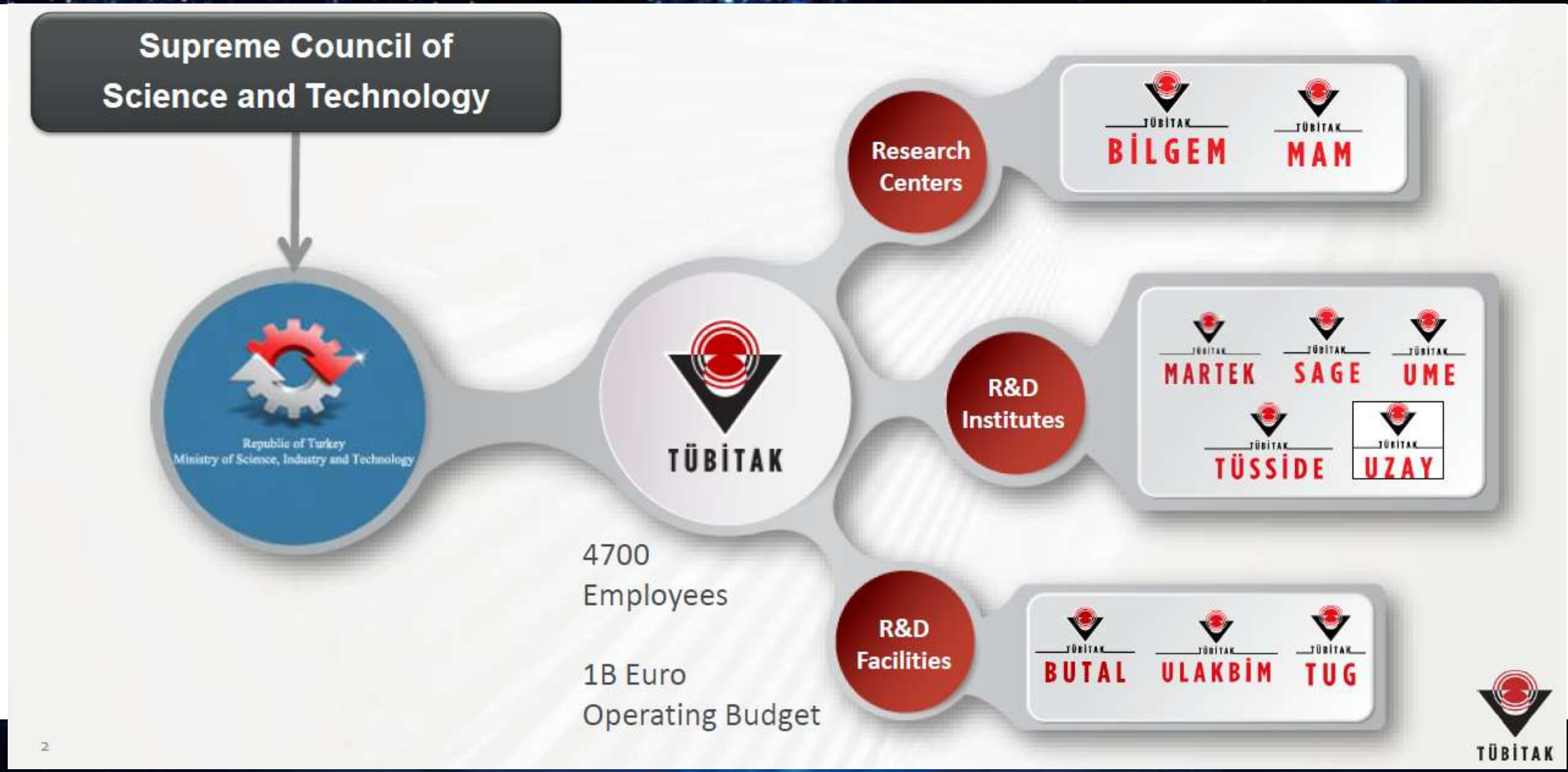
Paulet II-C

2018 - 2020

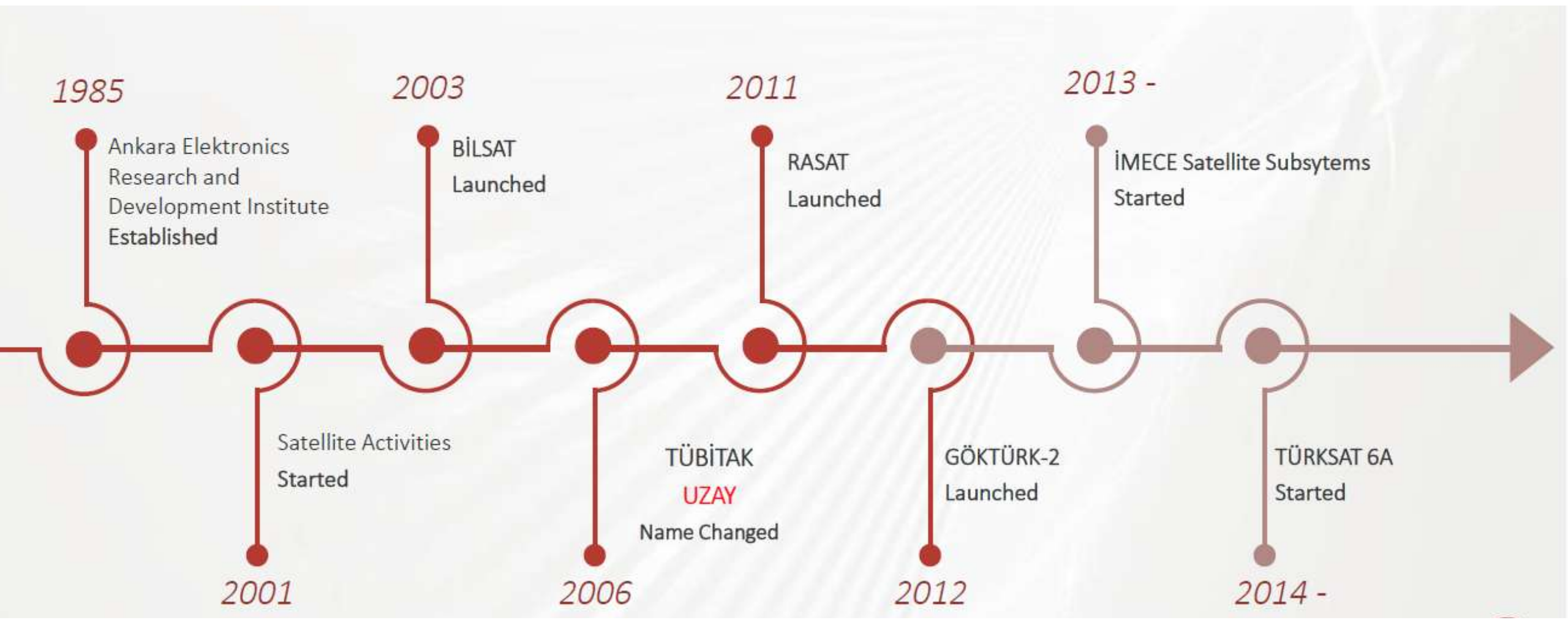
Paulet III

Individual Country Activities 4: Turkey

Individual Country Activities 4: Turkey



Individual Country Activities 4: Turkey



Individual Country Activities 4: Turkey

Satellite Technologies

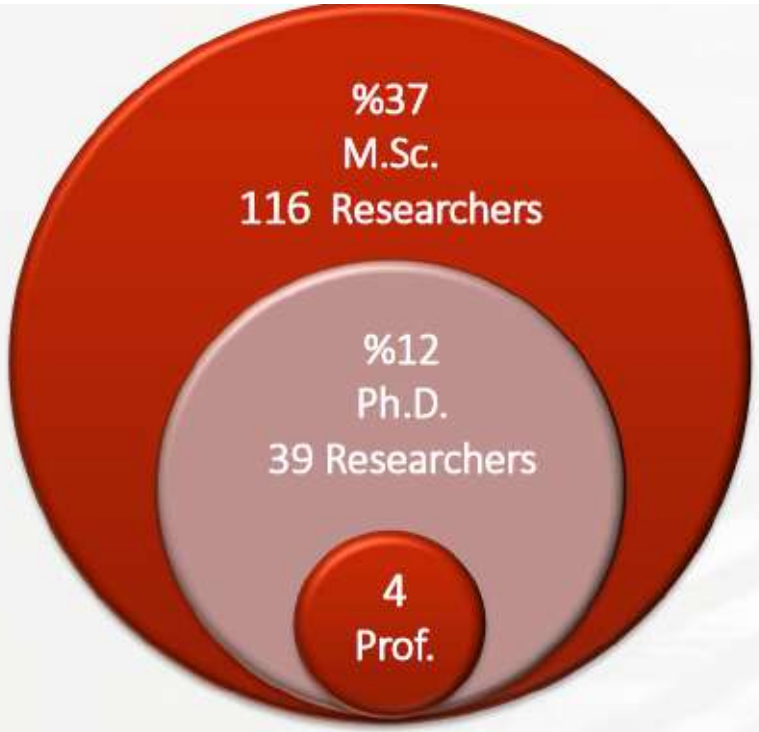
Aerospace Technologies

Remote Sensing
Data Fusion
Image Processing

Communication Systems

Optical Systems

Individual Country Activities 4: Turkey



Ongoing Academic Studies
Masters : 45
PhD : 39

Total Personnel : 314
Researchers : 230

Contracted Projects for next 5 years
23 Projects (Systems and subsystems level)
250 million Euros total project budget
50 million Euros proposal development

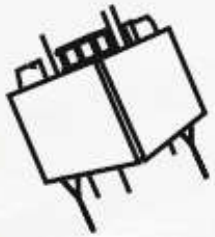
Annual Budget (projects+operating)
65 Million Euros
285K Euros/year/researcher

Individual Country Activities 4: Turkey

BİLSAT
2003

Technology Transfer

- SSTL Joint Program
- 12.6 m Resolution
- 129 kg total weight
- 686 km LEO
- Joint design, production, integration and testing.



RASAT
2011

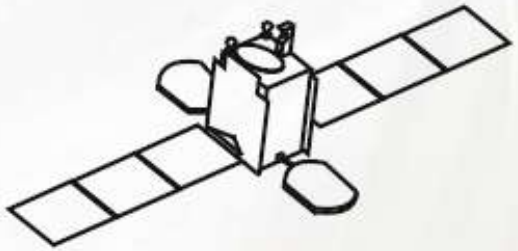
Remote Sensing

- 7,5 m resolution
- 94 kg total weight
- 686 km LEO
- Joint design, production, integration and testing.

GÖKTÜRK-2
2012

Indigenous Observation Satellite

- 2.5 m resolution
- 397 kg total weight
- 686 km yörünge yüksekliği
- Design, production, integration and testing

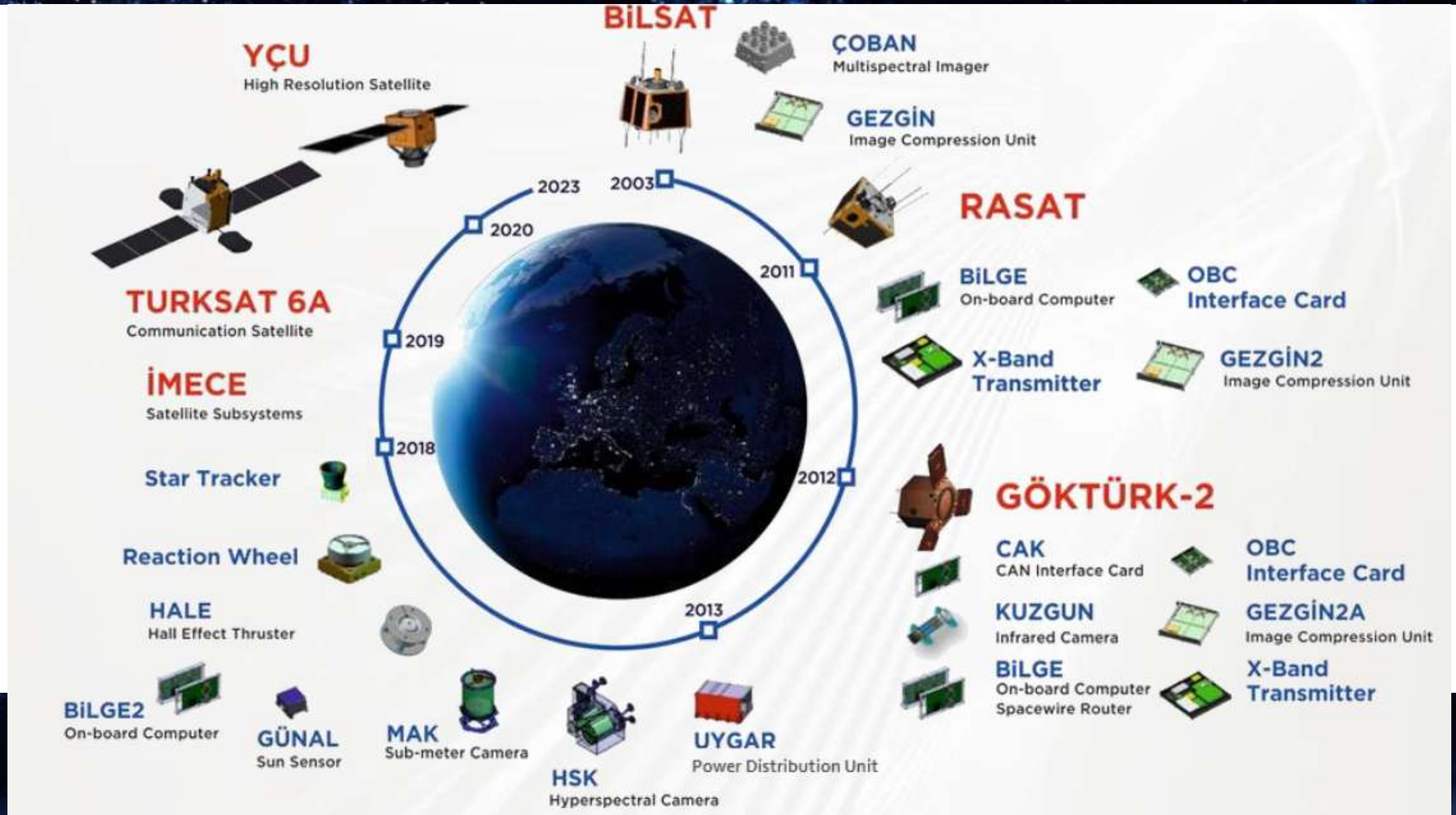


TÜRKSAT-6A
2020

Indigenous Communication Satellite

- 20 transponders
- 3500 kg total weight
- 36000 km GEO
- Design, production, integration and testing
- 42° East
- 15 years service lifetime

Individual Country Activities 4: Turkey

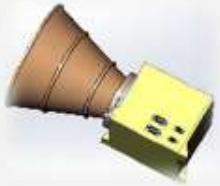


Individual Country Activities 4: Turkey

Communication Sub Systems

S-Band transmitter module / S-Band receiver module and Antennas

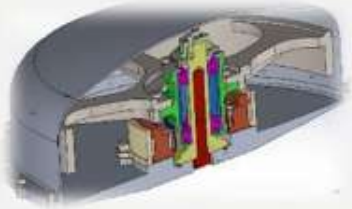
X Band transmitter and electronically steerable horn antenna



StarTracker

Orientation correctness: 100 arcsec

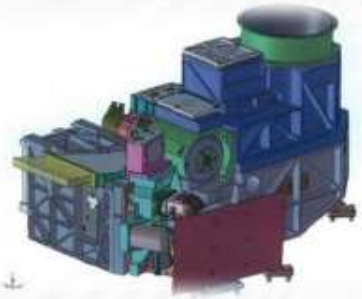
Output Update speed: 1-10 Hz



Reaction Wheel

Angular momentum: 15 Nms

Output Torque capacity: ≥ 200 mNm



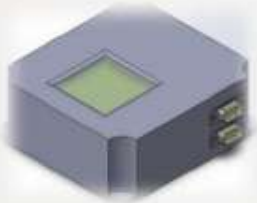
Hyperspectral Camera

< 40 m Ground Sampling Distance

9-20 nm Spectral resolution

400 – 2500 nm; 210 spectral bands (@ 10 nm resolution)

< 80 kg



Sun Sensor

Field of view: ±60°x60°

Sensitivity: 0.5° (3σ)

Flight Computer

High Resolution Camera

PAN ≤1m, RGB and NIR ≤4m

< 160 kg

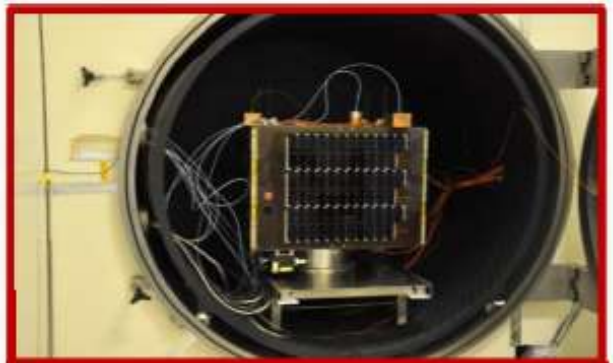
1m radius x 2.5m length

TÜBİTAK

Individual Country Activities 4: Turkey

CLEAN ROOMS

VIBRATION and MECHANICAL SHOCKS



ENVIRONMENTAL TESTS

ELECTRONIC PRODUCTION

GROUND CONTROL

GROUND SUPPORT

RELABILITY

HALL EFFECT THRUSTER

Individual Country Activities 4: Turkey

- International Society for Photogrammetry and Remote Sensing, ISPRS
- Disaster Monitoring Constellation, DMC
- Committee on Earth Observation Satellites, CEOS
- Group on Earth Observation, GEO
- The Consultative Committee for Space Data Systems, CCSDS
- EUROPRACTICE
- Asia-Pasific Space Technology Cooperation Organization, APSCO

isprs
information from imagery

dmc
International Imaging

CEOS

GEO GROUP ON EARTH OBSERVATIONS

EUROPRACTICE

CCSDS
The Consultative Committee for Space Data Systems

TÜBİTAK

Individual Country Activities 4: Turkey

FP7

- GAMALINK, Generic SDR-bAsed Multifunctional spAce LINK
- THOR, Innovative Thermal Management Concepts For Thermal Protection of Future Space Vehicles
- EOPOWER, Earth Observation for Economic Empowerment
- P2-ROTECT, Prediction, Protection & Reduction of OrbiTal Exposure to Collision Threats,
- COGSENSE, Cognitive and Cooperative Signal Processing Technologies for Remote Sensing Applications,
- SEOCA, GEO (Group on Earth Observation) Capacity Building in Central Asia

H2020

- FRACTION (Fractionated Architecture for Next Generation Earth Observation) Above threshold – not funded.
- GEO-CRADLE: Balkans, North Africa, Middle Eastern countries Remote sensing studies. Started on Feb 1, 2016.
- KACTUS (KA-band Communication Transceiver Unifying Small-sats) Above threshold – not funded.
- TEAMING Proposal CEO (Center of Excellence in Optics) Under preparation.

Final Remarks

- APSCO is a young but active regional intergovernmental space agency
- In parallel with training and technical actives, APSCO also promote space research to response the member states demands
- Member states of APSCO has also their own space programs and some of them cover also space science activities
- Yong generation in this region is encouraged to join space research, make fundamental preparation to your country for the next stage developments

APSCO

ASIA-PACIFIC SPACE COOPERATION ORGANIZATION

THANK YOU
FOR YOUR ATTENTION !